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ASSIGNMENT BOOKLET
SCN2261 Physics 20
Module 6 Assignment

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Date Assignment Submitted: ______	(If label is missing or incorrect) Student File Number: ______
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Physics 20

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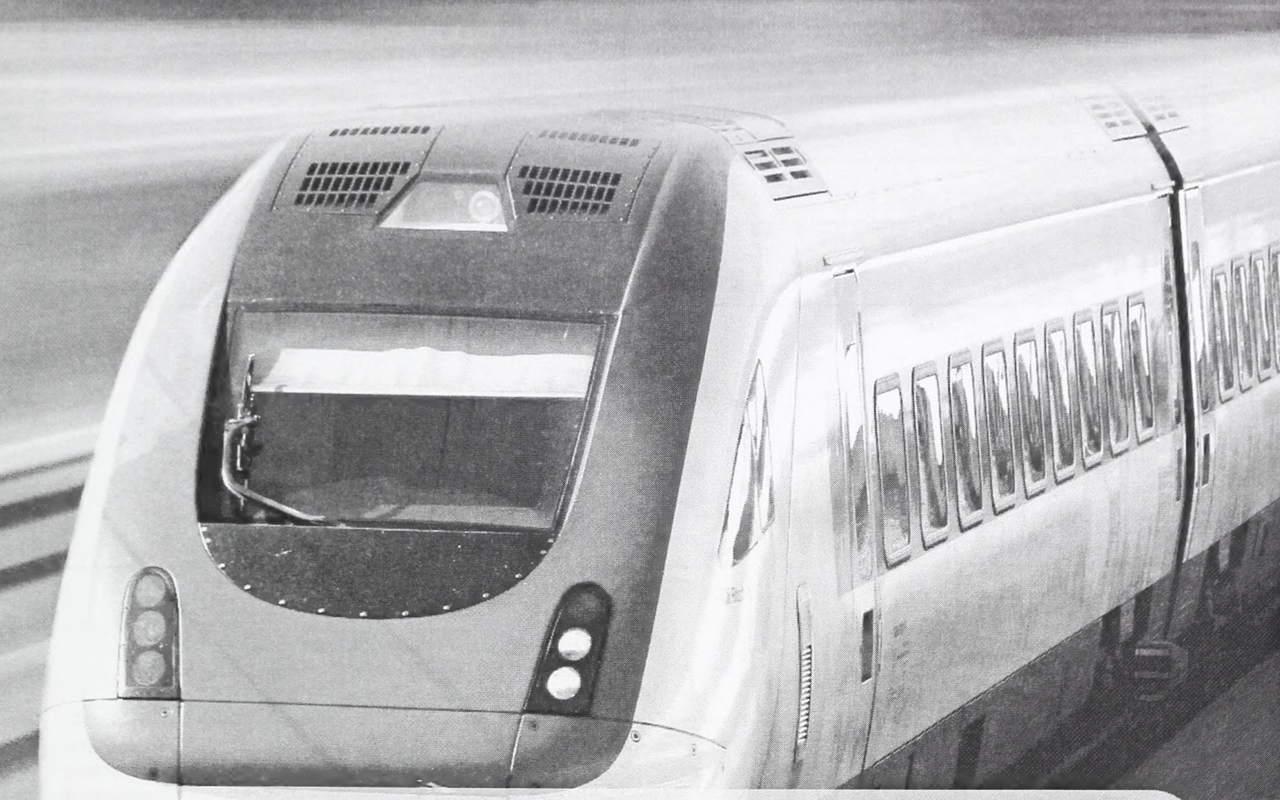

Module 6

WORK AND ENERGY

ASSIGNMENT BOOKLET

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Calgary Board of Education

Alberta Education

FOR TEACHER'S USE ONLY

Summary

	Total Possible Marks	Your Mark
Lesson 1 Assignment	24	
Lesson 2 Assignment	26	
Lesson 3 Assignment	31	
Lesson 4 Assignment	19	

Teacher's Comments

Physics 20
Module 6: Work and Energy
Assignment Booklet
ISBN 978-0-7741-3015-8

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Students	✓
Teachers	✓
Administrators	
Home Instructors	
General Public	
Other	

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- Alberta Education, **http://www.education.gov.ab.ca**
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MODULE 6: LESSON 1 ASSIGNMENT

This Module 6: Lesson 1 Assignment is worth 24 marks. The value of each assignment and each question is stated in the left margin.

(24 Marks) Lesson 1 Assignment: Work, Potential Energy, and Kinetic Energy

(1 mark) **TR 1.** A 2.20-N object is held 2.20 m above the floor for 10.0 s. How much work is done on the object?

(2 marks) **TR 2.** A 60.0-kg student runs at a constant velocity up a flight of stairs. If the vertical distance of the stairs is 3.2 m, what is the work done against gravity?

Hint: Use the formula $F_g = mg$.

(4 marks) **TR 3.** A 10.0-kg object is accelerated horizontally from rest to a velocity of 11.0 m/s in 5.00 s by a horizontal force. How much work is done on this object?

Hint: Use the following formula:

$$\left(a = \frac{v_f - v_i}{\Delta t} \right)$$

(2 marks) **TR 4.** A 90.0-N box is pulled 10.0 m along a level surface by a rope. If the rope makes an angle of 20.0° with the surface, and the force exerted through the rope is 75.0 N, how much work is done on the box?

(1 mark) **TR 5.** A 25.0-N object is held 2.10 m above the ground. What is the potential energy of the object with respect to the ground?

(2 marks) **TR 6.** The kinetic energy of a 20.0-N object is 5.00×10^2 J. What is the speed of this object?

(2 marks) **TR 7.** A 10.0-N object is accelerated uniformly from rest at a rate of 2.5 m/s^2. What is the kinetic energy of this object after it has accelerated a distance of 15.0 m?

(2 marks) **LAB 1.** Drag the object to the maximum height. What form is all of the energy in at this position? Is it gravitational potential energy or both gravitational energy and elastic potential energy? Explain your answer.

(2 marks) **LAB 2.** Where is the object located, relative to the equilibrium position, when it has the greatest kinetic energy? Explain why this occurs at this position.

(2 marks) **LAB 3.** What form of energy is present at the lowest position? Explain how this energy is stored differently than the energy stored at the highest position.

(1 mark) **LAB 4.** Explain why the potential and kinetic energies vary, as displayed in the graph. Select the mechanical energy graph for a hint!

(3 marks) **LAB 5.** Explain how gravitational potential energy, elastic potential energy, and kinetic energy interact during a bungee jump. You may use diagrams as part of your explanation.

MODULE 6: LESSON 2 ASSIGNMENT

This Module 6: Lesson 2 Assignment is worth 26 marks. The value of each assignment and each question is stated in the left margin.

(26 Marks) **Lesson 2 Assignment: Conservation of Mechanical Energy**

(1 mark) **LAB 1.** a. What is the total change in potential energy for the block when there is no friction present?

(1 mark) b. Where has this energy gone? How can you use this to find the velocity of the block as it reaches the bottom of the incline?

(2 marks) c. Calculate the velocity of the block at the bottom of the incline. Use the weight of the block from the data shown at the top of the simulation and the energy from the first graph.

(1 mark) **LAB 2.** Assume that the block has a potential energy of 0 J when it reaches the bottom of the incline. What can be said about the sum (mechanical energy) of the potential and kinetic energy for the block at any point on the way down the incline when no friction is present?

TR 1. Solve using energy considerations. Recall from the previous lesson that $E_p = \frac{1}{2} kx^2$. Since $F = kx$, $E_p = \frac{1}{2} Fx$.

(3 marks)

a. A rubber-band slingshot shoots a 25-g stone. What is the initial speed of the stone if the rubber band is drawn back 0.15 m with a force of 27 N?

(3 marks)

b. How high will the stone rise if it is shot straight upward?

TR 2. Solve these questions using energy considerations.

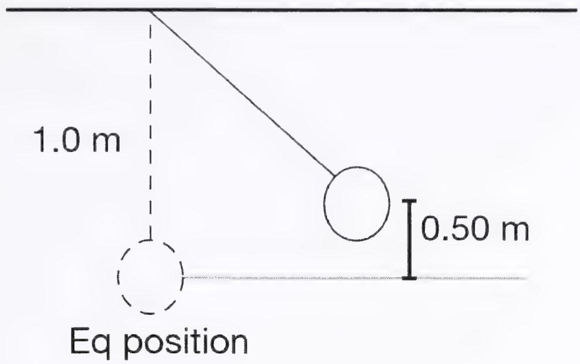
(2 marks)

a. A 0.80-kg coconut is growing 10 m above the ground in its palm tree. The tree is just at the edge of a cliff that is 15 m tall. What would the maximum speed of the coconut be if it fell to the ground beneath the tree?

(2 marks)

b. What would the maximum speed be if it fell from the tree to the bottom of the cliff?

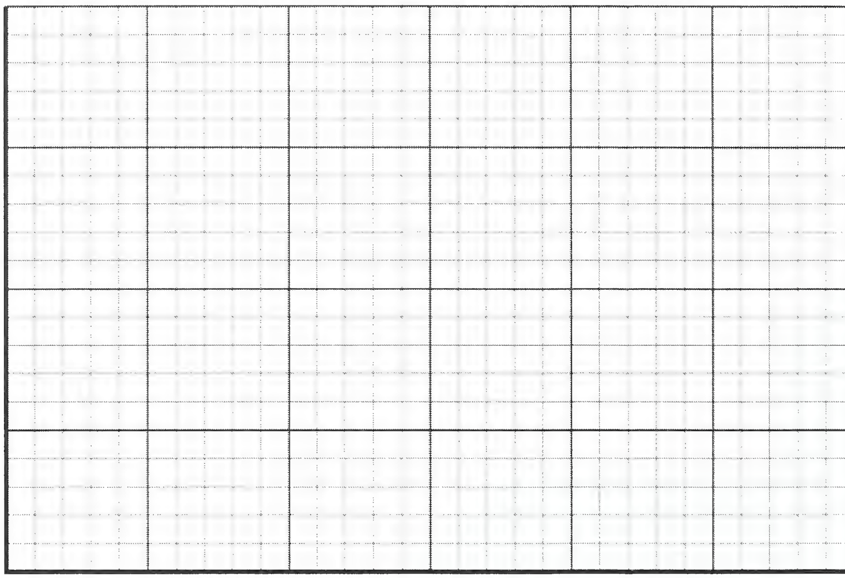
(2 marks) **TR 3.** A pendulum is dropped from the position as shown in the diagram (0.50 m) above the equilibrium position. What is the speed of the pendulum bob as it passes through the equilibrium position?



(4 marks) **LAB 3.** If necessary, re-open the Inclined Plane, Frictionless simulation.

Set the coefficient of friction to 0.2, and repeat the procedure. You may have to click "Zoom Out" several times to see the whole graph. Sketch the three graphs on the grid below. Label the lines and axes.

Energy vs. Time



Repeat several trials with greater coefficients of friction each time, up to a maximum of 0.55. Observe how the mechanical energy changes in each case.

(1 mark) **LAB 4.** a. What is the total change in potential energy for the block when there is friction present and the coefficient of friction is 0.20?

(2 marks) b. Has all this energy become kinetic? If not, where did it go?

LAB 5. Assume that the block has a potential energy of 0 J when it reaches the bottom of the incline.

(1 mark)

a. What can be said about the sum (mechanical energy) of the potential and kinetic energy for the block at any point on the way down the incline when friction is present?

(1 mark)

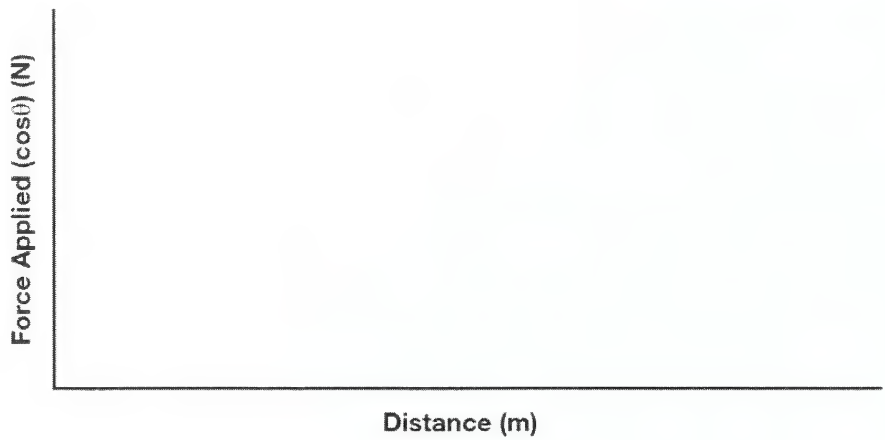
b. Is mechanical energy still conserved?

MODULE 6: LESSON 3 ASSIGNMENT

This Module 6: Lesson 3 Assignment is worth 31 marks. The value of each assignment and each question is stated in the left margin.

(31 Marks) **Lesson 3 Assignment: Mechanical Energy and the Work-Energy Theorem**

(4 marks) **LAB 1.** Click "Fit Graph to the Screen" (fit graph), and sketch it on your answer sheet.



(4 marks) **LAB 2.** Continue with the simulation by completing the following steps:

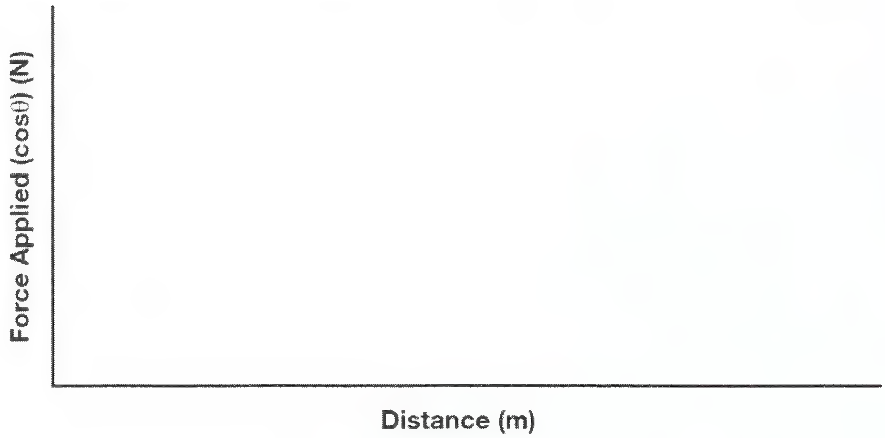
Enlarge the graph by dragging the right-hand side of the graph window to the right till you can see the last two buttons clearly. Determine the area (work) of the force-distance graph by pressing the "Integrate the Selected Graph" tool (∫) and dragging out the area under the graph from right to left. The area will be shown under the word "Output" at the top of the screen (Integral:). Record the area on your answer sheet.

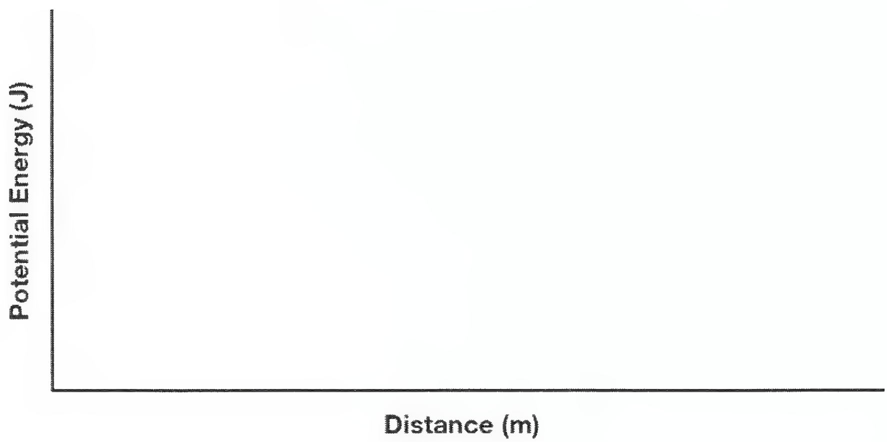
(4 marks) **LAB 3.** Change the vertical axis of the graph to "Potential Energy," and click the "Fit Graph to the Screen" (fit graph) button". Sketch the graph below. Click the "Options" button ( ). Select "Generate Table" to see the potential energy at the end of the motion. You can change the size of the columns in the data table by clicking on the title and dragging to the right. Record the potential energy at the end with the work done on the force-distance graph.

work (area) = __________ potential energy at the end = ___________

(2 marks) **LAB 4.** According to your results in LAB 1, LAB 2, and LAB 3, does the work done equal the gain in potential energy when work is done against a conservative force such as gravity? In this context, what does the term *conservative* mean?

(1 mark) **LAB 5.** Reset the simulation, and close the graph window. Repeat the steps outlined at the beginning of the procedure using a different path that ends up at the same spot as the one completed in LAB 1 ($y = 2.0$). **Note:** You have to delete any old graphs before making new ones.





work (area) = ________ potential energy at the end = ________

(1 mark) **LAB 6.** Work done is equal to the change in ______________.

(3 marks) **LAB 7.** In the following table, summarize your findings for three different paths that end at approximately the same spot.

Path	Change in Height (m)	Work Done (J)	Change in Potential Energy (J)	Length of Path (m)
1				
2				
3				

(1 mark) **LAB 8.** Based on your data above, does path independence hold when there are non-conservative resistance forces present?

(1 mark) **LAB 9.** How does the work done compare with the change in potential energy when non-conservative forces are present?

(1 mark) **LAB 10.** Is the work-potential energy theorem applicable when there are resistive or non-conservative forces present?

(1 mark) **LAB 11.** Fill in the blanks. If we think of the forces as a combination of conservative and non-conservative parts, then we can say that

work done = ______________________ + ______________________.

(4 marks) **TR 1.** Complete question 8 of “6.3 Check and Reflect” on page 323 of your textbook.

Discuss

In the discussion forum, propose an explanation for the following facts. Include a description of the energy transfers that would take place when the lift starts and stops.

(2 marks) **D 1.** If the chairlift engine fails, a brake system is required to prevent the chairlift from reversing directions.

(2 marks) **D 2.** A fully loaded chairlift requires more energy to start than it does to maintain its motion.

MODULE 6: LESSON 4 ASSIGNMENT

This Module 6: Lesson 4 Assignment is worth 19 marks. The value of each assignment and each question is stated in the left margin.

(19 Marks) Lesson 4 Assignment: Work and Power

(2 marks) **TR 1.** A garage door opener is rated at 373 W. How much work can it do in 14.0 s of operation?

(2 marks) **TR 2.** An automobile engine exerts a force of 595 N to propel the car at 90.0 km/h on a level road. What is the power output of the engine at that time?

(7 marks) **TR 3.** A traditional, double-seat chairlift can move 1200 people per hour (with an average mass of 60.0 kg) up a ski hill. A high-speed quad chair can move 2400 people in 30.0 minutes up the hill. If the upper terminal is 100 m higher than the lower terminal, how much power would each type of lift need just to overcome the force of gravity? Explain why they would need more power than the amount used to overcome the force of gravity.

(4 marks) **TR 4.** Complete question 6 of "6.4 Check and Reflect" on page 330 of the textbook.

Discuss

In the discussion forum, answer the following two questions.

(2 marks) **D 1.** Assumptions have been made in this lesson that the energy lost operating a low-speed chairlift is the same as the energy lost operating a high-speed lift of equal path length. Why is this assumption false? What impact does this have on the efficiency of the lift?

(2 marks) **D 2.** How could efficiency be maximized on a chairlift that can have anywhere from 0 to 2400 riders per hour?

Once you have completed all of the questions, submit your work to your teacher.